

# CDMA COMMUNICATIONS METHOD AND SYSTEM

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention relates to a CDMA (Code Division Multiple Access) communications method and system preferably applied to mobile communications.

### 2. Description of Related Art

CDMA communication systems carry out a primary modulation of original data to be transmitted by QPSK or the like, and a secondary modulation of the primary modulation signal to enlarge the bandwidth by a spreading code such as a PN code (Pseudo-Noise code). The bit rate of the spreading code is called a chip rate, which is several tens to several hundreds times higher than the bit rate of the original data. Each user performs communications using the same frequency band, and is identified by a spreading code.

Conventional CDMA systems arrange the original data into frames, perform the primary and secondary modulations of the frames, and transmit them. During communications, there are silent intervals, in which the modulations are stopped, and the transmission is interrupted. This prevents useless radio waves from being emitted, thereby suppressing interference power to other mobile stations. On the other hand, data whose transmission bit rate is less than that of voice coded data is transmitted by making vacant positions in a bit series in a frame, and stopping modulation of the vacant positions. The modulation is interrupted in either case. However, since the interruption is carried out in a random manner, the receiving side cannot utilize this vacant time for other purposes such as receiving broadcasting information transmitted from base stations.

Data rates of voice codecs for cellular systems range from 8–16 kbps. Low rate data (e.g., 1.2–4.8 kbps) as well as facsimile data is also handled as important cellular services. Furthermore, it will become necessary in the near future to transmit signals of the ISDN (Integrated Service Digital Network) in addition to the low bit rate data transmission. Image codecs currently available generally employ transmission rates of 64 kbps or 384 kbps. To achieve flexible transmissions of low rate data to high rate image data, the multimedia transmission including images requires code division multiplexing in the CDMA systems.

FIGS. 1A–1C illustrate a code division multiplexing method when a high rate transmission is carried out in a conventional CDMA system. FIG. 1A shows a fundamental channel whose fundamental transmission rate is  $f_b$  bps. A frame includes a synchronizing word SW, and a traffic channel TCH. FIGS. 1B and 1C illustrate the frame arrangements when the transmission rate is twice and four times that of the fundamental transmission rate, respectively. When the transmission rate is twice, that is,  $2f_b$  bps, two traffic channels are transmitted in parallel by using two different spreading codes (which is referred to as a two-channel parallel transmission) as shown in FIG. 1B, and when the transmission rate is four times,  $4f_b$  bps, the data is transmitted by the four-channel parallel transmission as shown in FIG. 1C.

When the transmission rate of a coded voice signal is 8 kbps, for example, and this transmission rate is adopted as the fundamental transmission rate of a fundamental channel, an 8-channel code division multiplexing is required to transmit data at a transmission rate of 64 kbps. Moreover, a

256-channel code division multiplexing is required to transmit data at a transmission rate of 2 Mbps.

The conventional CDMA systems determine the transmission rate of the coded voice signal which is most frequently used, as the fundamental transmission rate of the channel, and makes a frame corresponding to the fundamental transmission rate as the fundamental frame. A high-speed transmission such as multimedia transmission is performed by parallel transmission of a plurality of fundamental channels at the transmitting side, and by discriminating the individual channels by correlators at the receiving side. This presents a problem in that the circuit scale of a transmitter and a receiver increases with the degree of multiplexing.

Furthermore, in the CDMA mobile communications, communication quality will be degraded as a mobile station moves apart from a base station during communications. Accordingly, to maintain a high quality communication state, it becomes necessary to search for a new base station close to the mobile station during the communication and connect the mobile station to the new base station.

However, since a user occupies the entire frame for the communication, and there is no vacant time in the frame time for searching for a new base station to be connected, it is impossible to detect the new base station to which the mobile station switches the communication. Therefore, the detection must be performed at the base station side rather than the mobile station side. More specifically, both the base station which is communicating with the mobile station, and neighboring base stations receive the signal from the mobile station, measure the power of the received signal, and select the base station whose received signal has the maximum power as the new base station. This, however, presents a problem in that an amount of processing at the base station side increases with the increase in the number of the mobile stations. On the other hand, to perform this detection at the mobile station side, the mobile station must be provided with another secondary demodulation system (or decorrelator) for measuring the power of the control channels transmitted from neighboring base stations.

Each base station continuously or periodically transmits, through a common control channel, position information of the base station, and spreading codes used by the neighboring base stations, as well as communication data to mobile stations. In addition, broadcasting data such as weather forecast and stock prices, and paging data can also be transmitted. To receive these data (broadcasting data or paging data) during the communication, a conventional mobile station requires another demodulation system in addition to the demodulation system for the original communications.

Providing two demodulation systems in the mobile station presents a problem in that it will increase size, weight, and consuming power of the mobile station.

## SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a CDMA communications method and system which can implement variable rate data transmission from a high-rate to low-rate with a small amount of an increase in circuitry of transceivers.

Another object of the present invention is to provide a CDMA communications method and system which can detect a base station, to which a mobile station is to be newly connected, at the mobile station side during the communication.